

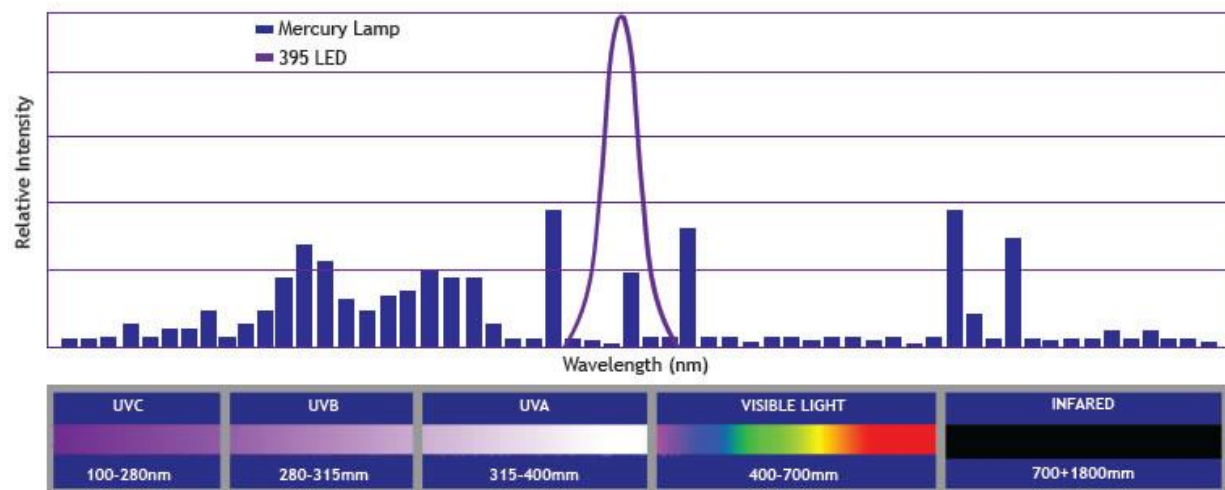


LAMBSON
Leading the way

Photoinitiators for LED Curing



LED Light Sources



Source: Phoseon

Light Sources:

Mercury lamps

- Medium Pressure Mercury Lamp
- Doped Mercury Lamps

LED Lamps

- 365 nm
- 385 nm
- 395 nm



Image source: Jenton International

Far UV	UV C	UV B	UV A	Near Vis
200-240nm	240-280nm	280-320nm	320-400nm	400-450nm
Short wave UV Surface cure		Medium wave UV High speed	Long wave UV Depth cure	UV-Vis Depth cure



Advantages & Disadvantages

LED lamp technology becoming increasingly important in modern energy curing

Advantages

- Reduced cost/energy of running lamps
- No warm up time. On/Off lamps
- No ozone generation
- Cold cure
- Improved safety
- Long bulb lifetimes compared to mercury

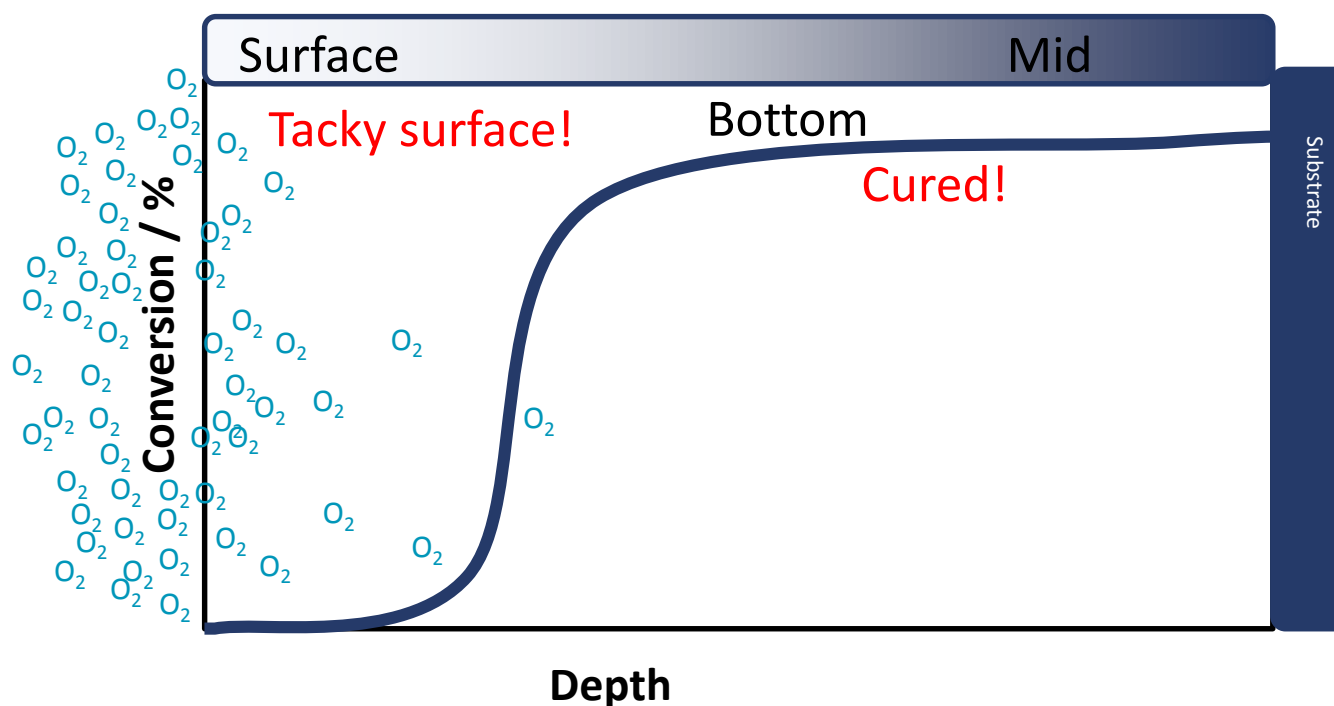
Disadvantages

- Few spectral outputs
- Low power lamps
- Few photoinitiators appropriate
- Yellowing often a problem
- Difficult to achieve effective surface cure

Formulation must be adapted to account for change in lamp technology



Oxygen Inhibition



A competing, undesired reaction to polymerization in free radical UV cure.

Overcoming Oxygen Inhibition

Photoinitiators:

- Higher concentrations
- Combinations of PIs

Amines:

- Aromatic amines or acrylated amines

Resin selection:

- High functionality
- Polyether acrylates

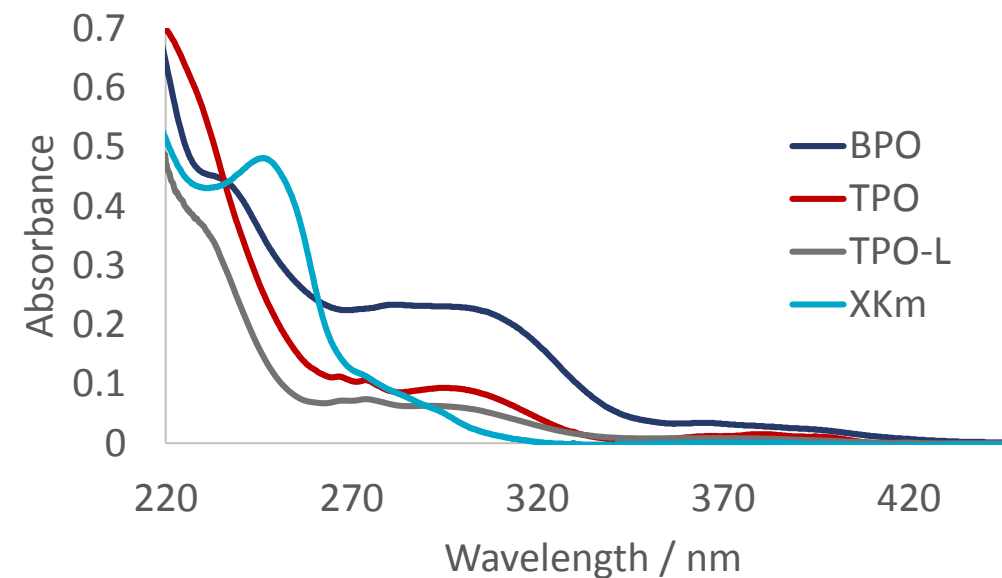
Physical methods:

- N₂ inertion
- Lamination
- Waxes
- High viscosity



Type I: Phosphine Oxides

Photoinitiator Name	Structure
SpeedCure TPO-L	
SpeedCure TPO	
SpeedCure BPO	
SpeedCure XKm	



Features:

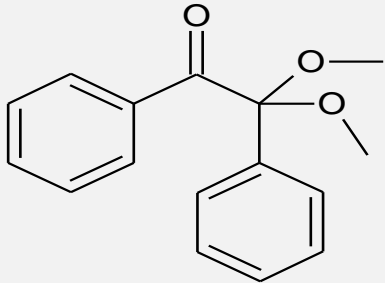
- Depth Cure
- Long wave UV absorbance
- Photobleaching
- SpeedCure XKm also has Type II functionality (hybrid)

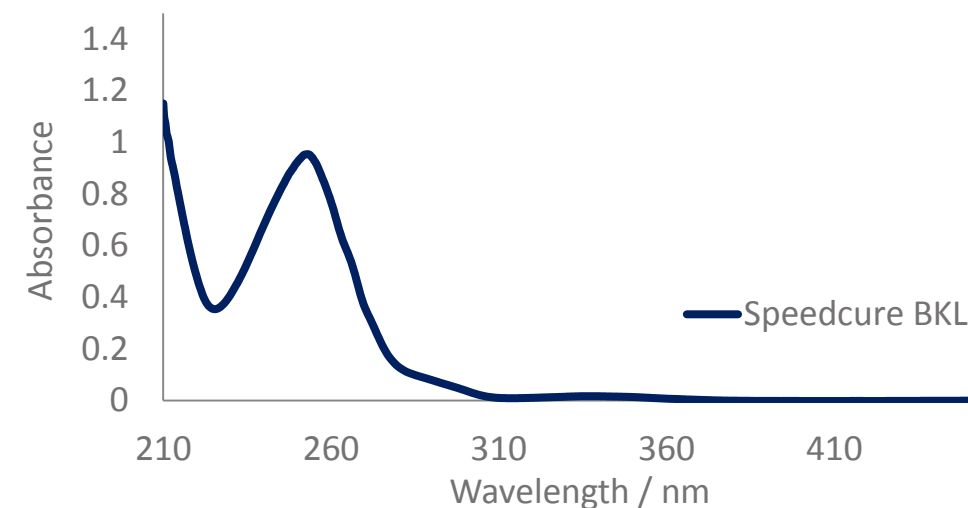
Applications:

- Thick coatings
- Composites & CIPP
- TiO₂ pigmented coatings
- Adhesives



Type I: Benzil Ketal

Photoinitiator Name	Structure
SpeedCure BKL	



Features:

- General purpose
- Short wave UV absorbance
- Very fast rate of cleavage
- High thermal stability
- Some yellowing and odour

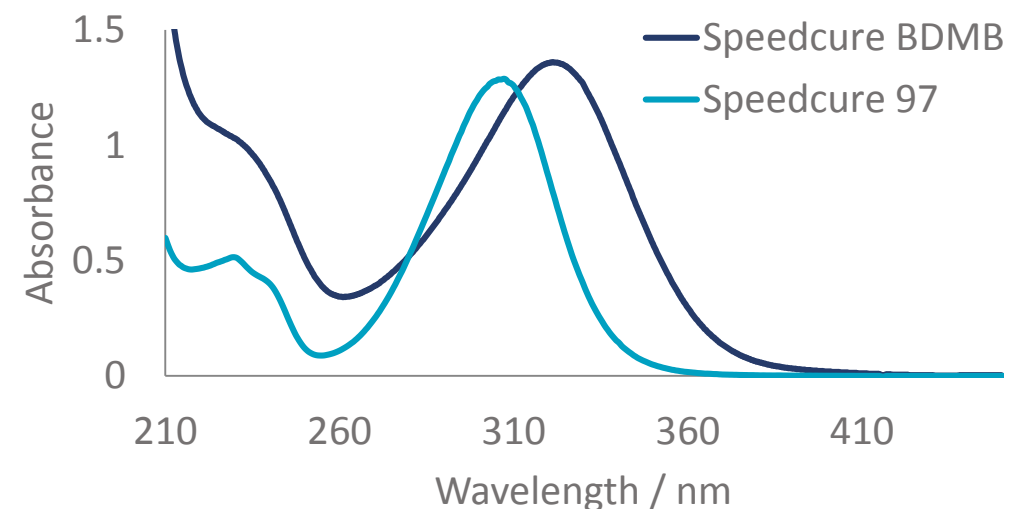
Applications:

- Clear and pigmented coatings
- Adhesives
- Styrene or unsaturated polyester based coatings



Type I: Aminoacetophenones

Photoinitiator Name	Structure
SpeedCure BDMB	
SpeedCure 97	



Features:

- Mid range absorption
- Depth and surface cure
- Sensitized by SpeedCure ITX

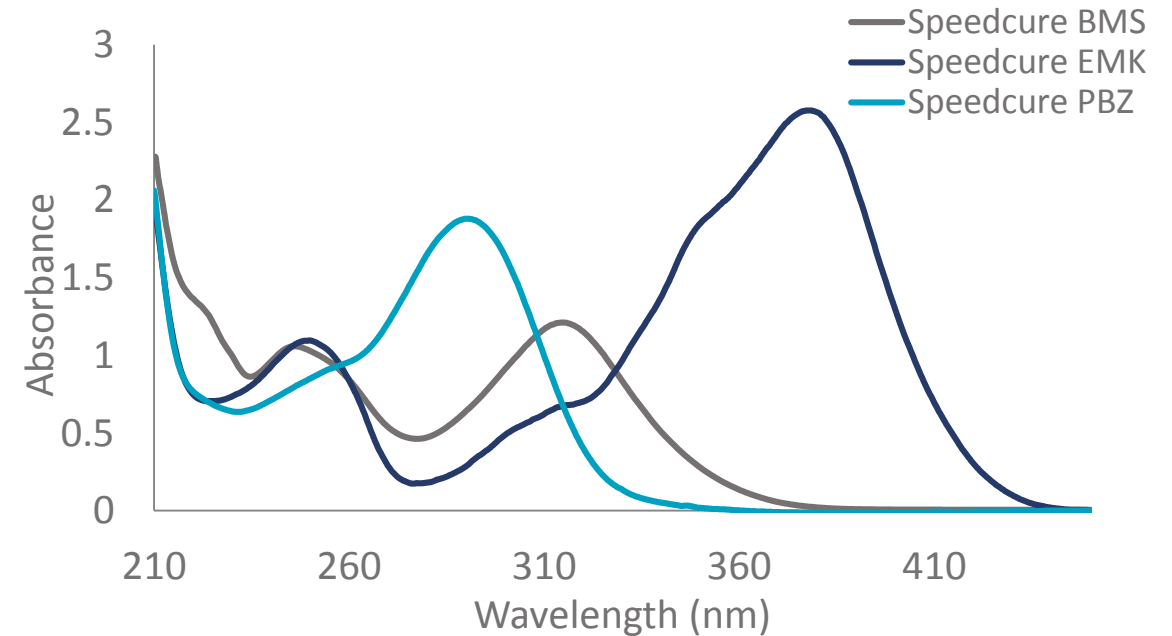
Applications:

- High speed inks
- Electronics
- Etch resist
- Solder mask



Type II: Benzophenones

Photoinitiator Name	Structure
SpeedCure BMS	 <chem>CC1=CC=C(C=C1)S(C(=O)C2=CC=CC=C2)C3=CC=CC=C3</chem>
SpeedCure PBZ	 <chem>C(C)(C)C(=O)C1=CC=C(C=C1)C2=CC=CC=C2</chem>
SpeedCure EMK	 <chem>CCN(CC)C1=CC=C(C=C1)C(=O)C2=CC=C(C=C2)N(CC)CC</chem>



Features:

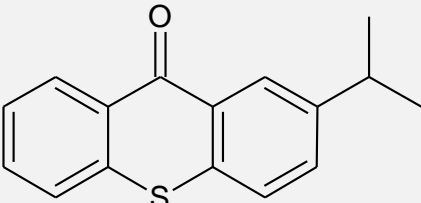
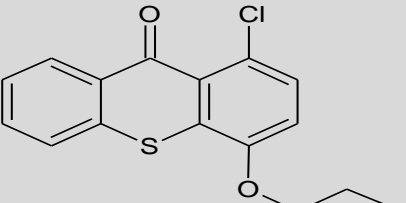
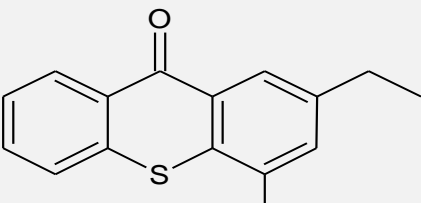
- Mid to long wavelength absorption
- Surface and depth cure
- High reactivity
- SpeedCure EMK can also act as an amine synergist and sensitizer

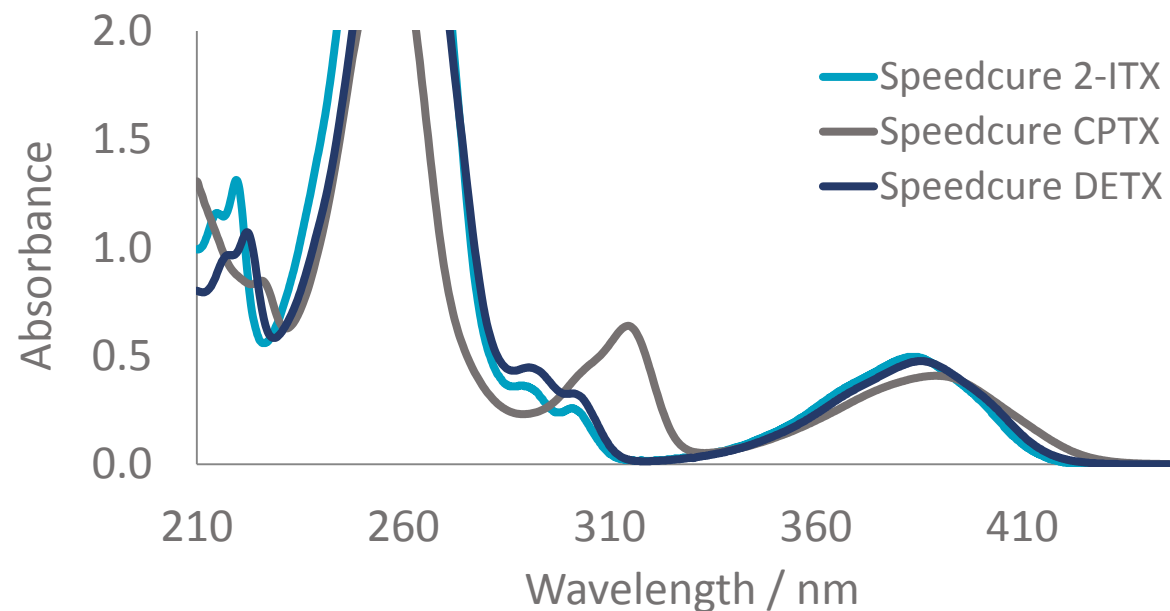
Applications:

- Pigmented systems
- LED Curing



Type II: Thioxanthenes

Photoinitiator Name	Structure
SpeedCure ITX	
SpeedCure DETX	
SpeedCure CPTX	



Features:

- Long wavelength absorption
- Depth cure
- Photoinitiator & sensitizer
- Used with amine synergist
- Yellowing

Applications:

- Pigmented systems
- LED curing
- Cationic sensitizer

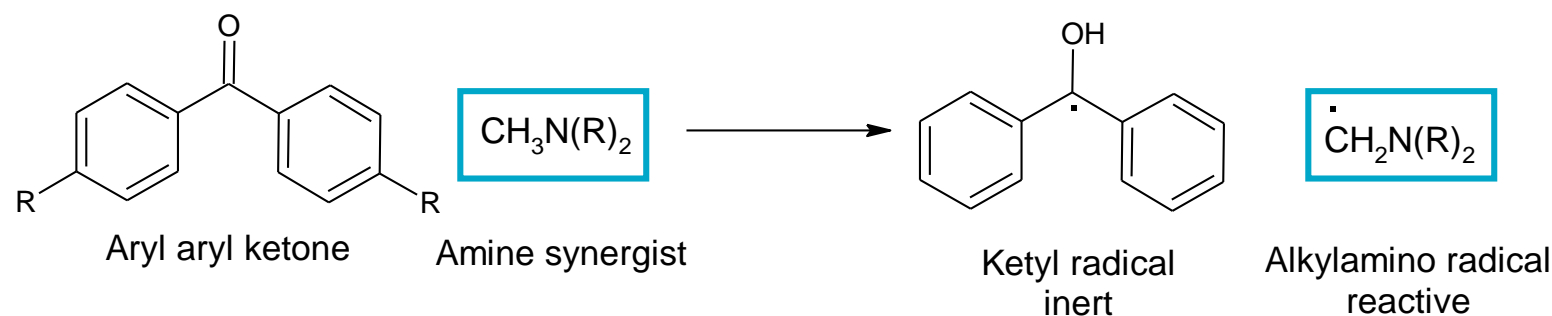


Amine Synergists

Amines act synergistically with Type II photoinitiators and have other important roles such as, oxygen scavenging, solvency and affecting water uptake in ink formulations.

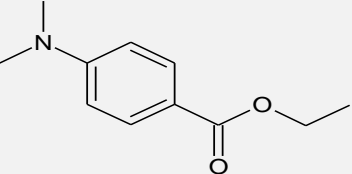
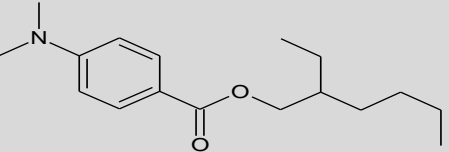
Care should be taken when formulating to avoid acidic environments which may neutralize the amine and inhibit reactivity.

In water-based systems low pH should be avoided as this can reduce the reactivity of the amine synergist.





Amine Synergists

Product Name & Chemistry	Structure	Features
SpeedCure EDB Aminobenzoate		Solid. Very fast cure. Suitable for offset litho inks.
SpeedCure EHA Aminobenzoate		Liquid, easy to incorporate. Less reactive than SpeedCure EDB. Suitable for flexo inks.

SpeedCure Amine synergists are predominantly based on aminobenzoate chemistry:

Aminobenzoates are much more reactive than simple tertiary amines and exhibit lower “bloom”.

Aminobenzoates are insoluble in water and so are suitable for lithographic applications where water/ ink balance is critical.



LAMBSON

Leading the way



With offices and facilities in England, Europe, India, China, Japan and America we offer a truly Global Supply Network.

**Thank you for your attention
Questions?**